MODULAR VOLUMETRIC COMPRESSOR.

The present invention concerns a volumetric compressor, particularly suited to be used in air conditioning and/or refrigeration systems.

It is known that in air conditioning and/or refrigeration systems volumetric compressors are used, which are suitable for circulating a carrier fluid inside a closed circuit for air conditioning in closed spaces or for the refrigeration of cold rooms and similar structures.

Though in their different specific applications, the volumetric compressors manufactured according to the prior art are all constituted by a casing in which it is possible to identify a carrier fluid suction chamber, provided with a suction valve and a carrier fluid delivery chamber, provided with a delivery valve, with a pair of screw rotors included between them.

For the different applications mentioned above, different types of volumetric compressors are available on the market; in particular, when they are used for the construction of air conditioning systems, they are provided, inside the casing, with a semi-hermetic motor unit for the operation of the rotors and with a lubricating oil separator positioned before the delivery valve.

Volumetric compressors, indeed, are equipped with a hydraulic circuit for the lubrication of the rotors that is suited to improve their efficiency; the lubricating oil is mixed with the carrier fluid inside the compressor and consequently it must be separated from the latter before being conveyed to the air conditioning circuit.

For the refrigeration systems, on the other hand, volumetric compressors, similar to those described above, are generally used, that is, compressors comprising a casing inside which there is a semi-hermetic motor unit including a suction chamber provided with a suction valve and a delivery chamber provided with a delivery valve, with a pair of screw rotors included between them, in which, however, there is no lubricating oil separator.

In the refrigeration systems, indeed, two or more compressors arranged in parallel are often used, and a single lubricating oil separator is used for all the compressors making up the system.

A further possible configuration of the volumetric compressor, used for example for particularly aggressive fluids like ammonia, differs from those previously described owing to the fact that it is not provided with a motor unit inside the compressor casing.

In this case the compressor, called "open type" compressor, is equipped with drive and coupling means for connection to an external motor unit for the operation of the rotors.

The known volumetric compressors mentioned above, however, have some drawbacks that have been recognised as such.

The main drawback is represented by the fact that in order to meet the customer's different needs, according to the combinations described above, the manufacturer must produce different compressors.

Another drawback, connected to the previous one, is represented by the fact that, to obtain the constructional differences necessary to implement all the combinations mentioned and, therefore, to design and manufacture the different types of compressors, too many persons and means are required.

A further drawback is represented by the fact that if the customer needs a compressor with a configuration different from the one installed, he should obviously replace it with a new one capable of satisfying the new requirements of the system.

A situation of this kind occurs, for example, if the customer needs to pass from an external motor unit to a semi-hermetic motor unit associated with the suction head of the compressor.

The present invention aims to eliminate all the drawbacks listed above.

It is a first aim of the invention to carry out a volumetric compressor that makes it possible to reduce the number of components required to obtain all the types of compressor described by unifying their common parts.

It is another aim of the invention to carry out a volumetric compressor whose construction technique can be simplified compared to the prior art, with consequent reduction in design and construction costs.

It is a further aim of the invention to carry out a volumetric compressor that may be modified during manufacture with no need to replace it if its configuration must be changed.

The aims described above have been achieved through the implementation of a volumetric compressor that, according to the main claim, comprises a pair of rotors cooperating with each other and housed inside a compressor body in which it is possible to identify a first flange, positioned on the suction side of said compressor body, and a second flange, positioned on the delivery side of said compressor body, said first flange being suited to be coupled with a

suction head and said second flange being suited to be coupled with a delivery head of said volumetric compressor, and is characterized in that said suction head is provided with a first counterflange suited to be connected to said first flange and comprises a coupling element for connection to a suction pipe, or a coupling element for connection to a suction pipe in combination with a motor unit, and in that said delivery head is provided with a second counterflange suited to be connected to said second flange and comprises a coupling element for connection to a delivery pipe, or a coupling element for connection to a delivery pipe in combination with an oil separator.

Advantageously, the possibility to connect the same compressor body to two different types of suction head on the suction side and to two different types of delivery head on the delivery side makes it possible to achieve all the compressor configurations required by the market, using five different components, instead of making four separate compressors.

Still advantageously, the possibility to removably connect the suction and delivery heads to the compressor body, through a connection with flange and counterflange, allows the configuration of the compressor to be modified even after its first installation.

The aims and advantages mentioned above will be highlighted in greater detail in the description of a favourite application of the invention, given as an example without limitation with reference to the enclosed drawings, wherein:

- Figure 1 is an exploded view of all the components of the volumetric compressor of the invention;
- Figures from 2 to 5 show different executive embodiments of the compressor of the invention, that can be obtained using the components shown in Figure 1.

As can be observed in Figure 1, the volumetric compressor of the invention, indicated as a whole by **1**, comprises a pair of rotors **2** cooperating with each other and housed inside a compressor body **3** in which it is possible to identify a first flange **4** arranged on the suction side of said compressor body **3** and a second flange **5** arranged on the delivery side of said compressor body **3**, said first flange **4** being suited to be coupled with a suction head **6**, **7** and said second flange **5** being suited to be coupled with a delivery head **8**, **9** of said volumetric compressor **1**.

According to the invention, the suction head **6**, **7** is provided with a first

counterflange **10, 11** suited to be connected to said first flange **4** and includes a coupling element **12** for connection to a suction pipe, or a coupling element **13** for connection to a suction pipe in combination with a motor unit **14**, and said delivery head **8, 9** is provided with a second counterflange **15, 16** suited to be connected to said second flange **5** and includes a coupling element **17** for connection to a delivery pipe, or a coupling element **18** for connection to a delivery pipe in combination with an oil separator **19**.

Figures from 2 to 5 show the different configurations **50, 60, 70, 80** of the compressor **1** of the invention, that can be achieved by connecting to the compressor body **3** the different suction heads **8, 9** and delivery heads **10, 11** shown in Figure 1, by fastening each flange **4, 5** of the compressor body **3** to the counterflange **10, 11, 15, 16** of the suction head **6, 7** or of the delivery head **8, 9**.

In particular, Figure 2 shows the configuration **50** that involves the installation, on the suction side of the compressor body **3**, of a head **7** comprising a coupling element **13** for connection to a suction pipe in combination with a motor unit **14**, preferably but not necessarily semi-hermetic, while on the delivery side of the compressor body **3** there is a head **8** comprising a coupling element **18** for connection to a delivery pipe in combination with an oil separator **19**.

This type of configuration is the most widespread in air conditioning systems that must be equipped with a compressor **50** with compact dimensions that integrates all the elements necessary for the operation of the circuit which generally requires one compressor only.

As to the semi-hermetic motor unit **14** that operates the rotors **2** housed inside the compressor body **3**, this is generally constituted by an electric motor cooled by the carrier fluid itself.

For the refrigeration of cold rooms and similar structures, in order to achieve the performance required by the system it is often necessary to use a certain number of compressors **80** arranged in series.

In this case, each volumetric compressor **80** is equipped with an independent, semi-hermetic motor unit **14**, while the filtration of the carrier fluid takes place in a common external oil separator that serves all the compressors making up the system, towards which all the delivery pipes of each compressor converge.

Thus, for this type of system, volumetric compressors **80** of the type shown in

Figure 5 are used, in which the suction head **7**, connected to the compressor body **3** on the suction side, comprises the coupling element **13** in combination with the motor unit **14**, while the delivery head **9** connected to the compressor body **3** on the delivery side comprises only the delivery valve conveying the carrier fluid to the external oil separator.

Figure 4 shows a further configuration **70** of the volumetric compressor **1** of the invention, in which the suction head **8**, connected to the compressor body **3** on the suction side, comprises only the coupling element **12** for connection to a suction pipe, while the delivery head **8** connected to the compressor body **3** on the delivery side comprises the coupling element **18** for connection to a delivery pipe in combination with the oil separator **19**.

The last configuration **60** of the compressor **1** of the invention, that can be obtained with the components **6**, **9** represented in Figure 1, is that shown in Figure 3, in which the suction head **6** connected to the compressor body **3** on the suction side comprises only the coupling element **12** for connection to a carrier fluid suction pipe, while the delivery head **9**, connected to the compressor body **3** on the delivery side, comprises only the coupling element **17** for connection to a carrier fluid delivery pipe.

The suction head **6** is equipped with drive means **20** suited to be set in motion by the motor unit of the system and to transmit motion to the rotors **2** housed inside the compressor body **3**.

This type of compressor **60** is particularly suited to be installed in systems that use particularly aggressive carrier fluids, for example ammonia, which may damage the motor unit in case of contact with the latter.

As to the compressor body **3**, this may be sized according to the power required and to the type of carrier fluid used in the circuit, though maintaining a first flange **4**, arranged on the suction side, and a second flange **5**, arranged on the delivery side, suited to house corresponding counterflanges **10**, **11**, **15**, **16** for the connection of the suction heads **6**, **7** and the delivery heads **8**, **9** shown in Figure 1.

The sizing of the compressor body **3** is generally achieved by varying the longitudinal development of the rotors **2** housed inside it and consequently the longitudinal development of the compressor body itself.

Thus, it is obvious that, by combining compressor bodies of different sizes with the suction heads **6**, **7** and the delivery heads **8**, **9** shown in Figure 1, it is

possible to obtain multiple configurations of the compressor, reducing the number of components to be manufactured and kept in stock, with no need to have a specific compressor for each application, as was the case in the prior art described above.

The possibility to have a volumetric compressor **1**, **50**, **60**, **70**, **80** in which it is substantially possible to identify three interchangeable functional units, that is, a compressor body **3**, a suction head **6**, **7** and a delivery head **8**, **9**, makes the compressor **1**, **50**, **60**, **70**, **80** of the invention modular and, therefore, easy to be adapted to the different needs of the user, simply by assembling the components in different ways.

As to the coupling element **12**, **13** for connection to a suction pipe for the carrier fluid at low pressure and the coupling element **17**, **18** for connection to a delivery pipe for the carrier fluid at high pressure, they may be constituted, according to the customer's needs, by a suction and/or delivery valve or, alternatively, by a suction and/or delivery coupling.

As to the connection of the suction heads **6**, **7** and delivery heads **8**, **9** to the compressor body **3**, it takes place through a coupling between flange **4**, **5** and counterflange **10**, **11**, **15**, **16** that is made integral through suitable fastening means **21** of the known type, for example screws.

According to the above, it can be understood that the volumetric compressor of the invention achieves all the aims set.

In particular, it is achieved the aim to carry out a volumetric compressor in which, owing to its modular nature, the number of components necessary to obtain the different configurations required by the users is reduced.

It is also achieved the aim to carry out a volumetric compressor whose construction technique can be simplified compared to the prior art, thus obtaining a reduction in design and construction costs.

Finally, it is also achieved the aim to carry out a volumetric compressor whose configuration may be modified even after its first installation to meet, for example, new needs of the system, or to be reinstalled in a new system.

Upon implementation, modifications and changes that are neither described nor represented may be made to the volumetric compressor object of the invention.

The embodiments described and any other that have not been mentioned are to be considered protected by the present patent, provided that they fall within

the scope of the claims expressed below.